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(54) **A disc brake device provided with a brake release controlled by fluid pressure**

(57) The device, for braking a shaft 1, has a housing 4 which is closed by a cover 10 (Figures 1—3, 6) or by a cover 10 and a resilient associated washer 46 (Figures 4, 5) to define a closed chamber 11; the chamber 11 has brake disc(s) 12 rotationally fast with shaft 1 and brake lining(s) 13 fast with housing 4 and the brake 12, 13 is engaged by a resilient bias provided by a compression spring 18 e.g. a resilient washer acting on the cover or by the cover itself; release fluid is supplied to chamber 11 to move at least part of the cover 10 to release the brake.

The release fluid may be supplied via a duct 54, in the shaft (Figures 4, 6); the shaft may pass through a central opening in the cover (Figures 1, 4, 6) or the cover may be imperforate (Figures 2, 3, 5).

Fig.1

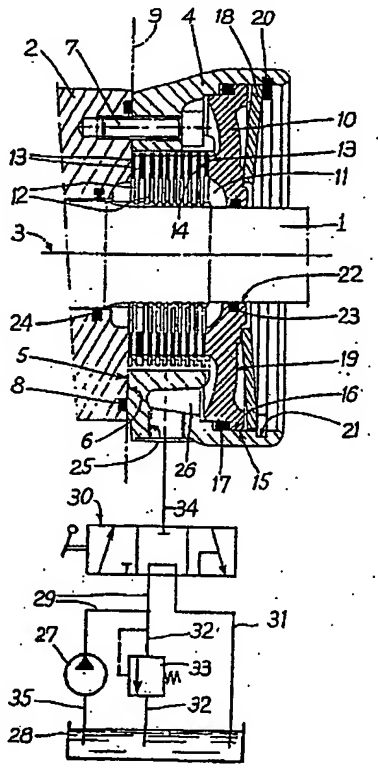

Fig.4

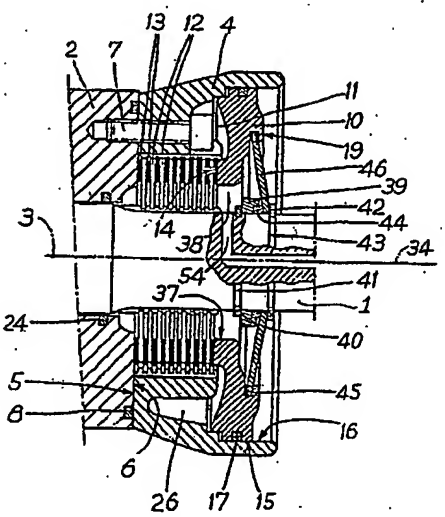

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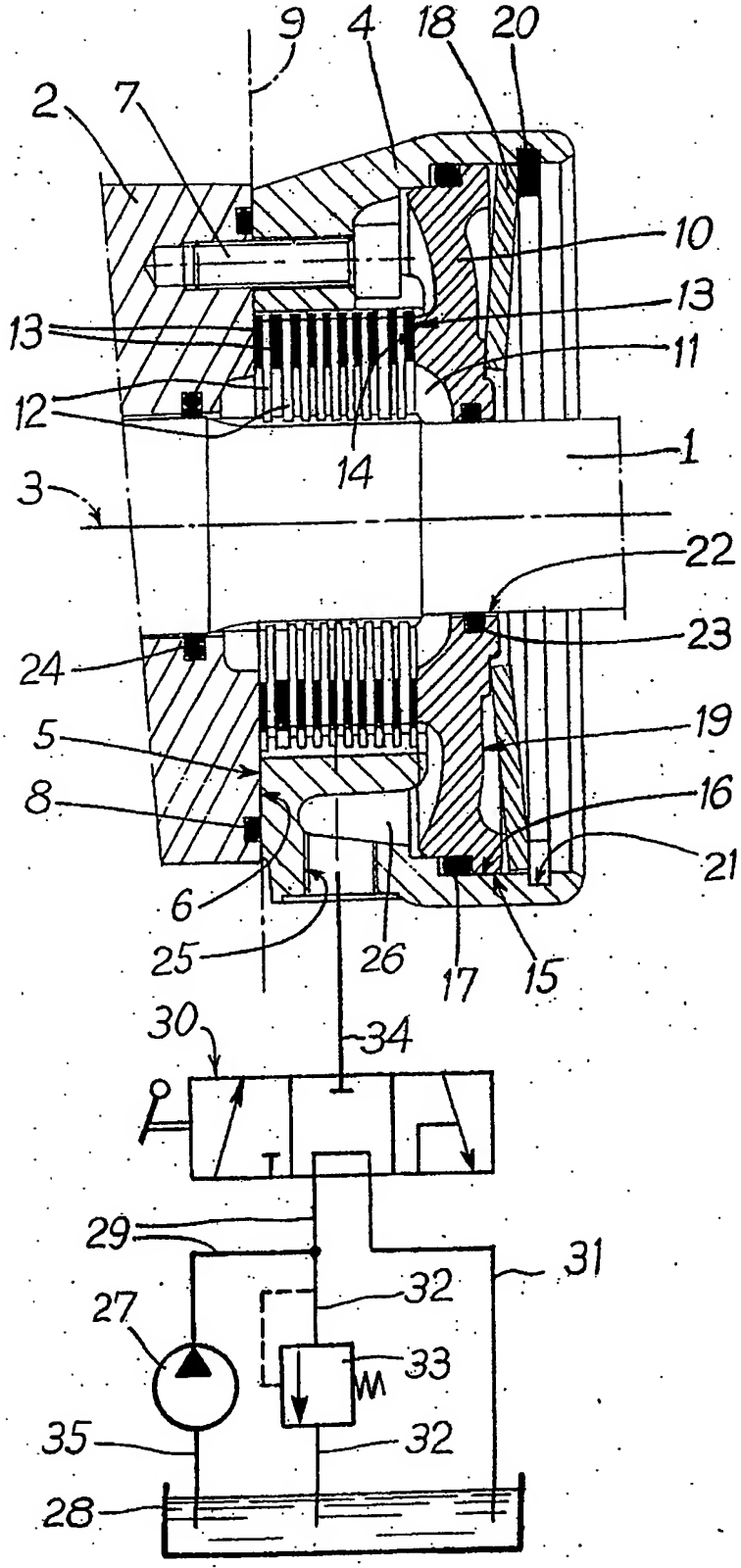
Fig.1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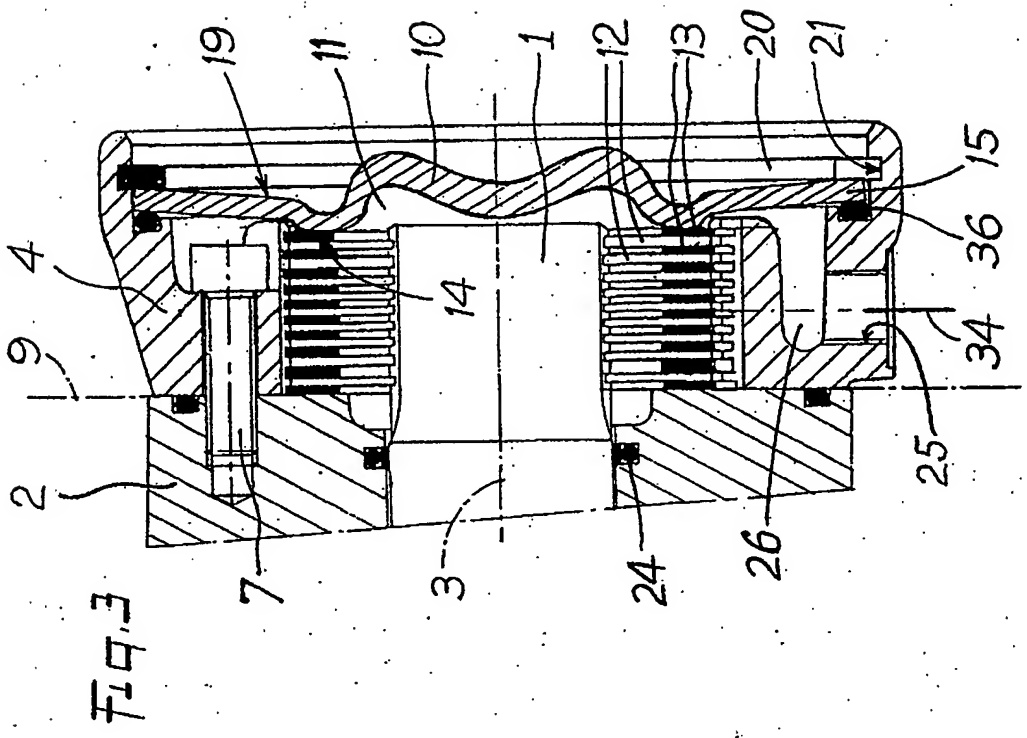
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Fig.3

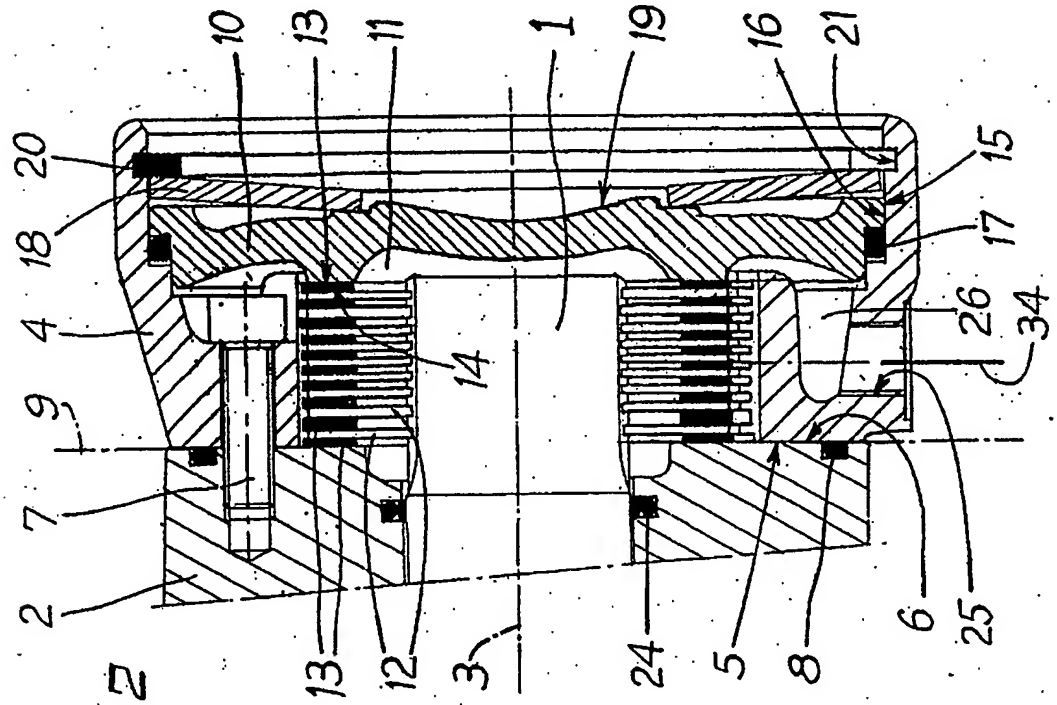
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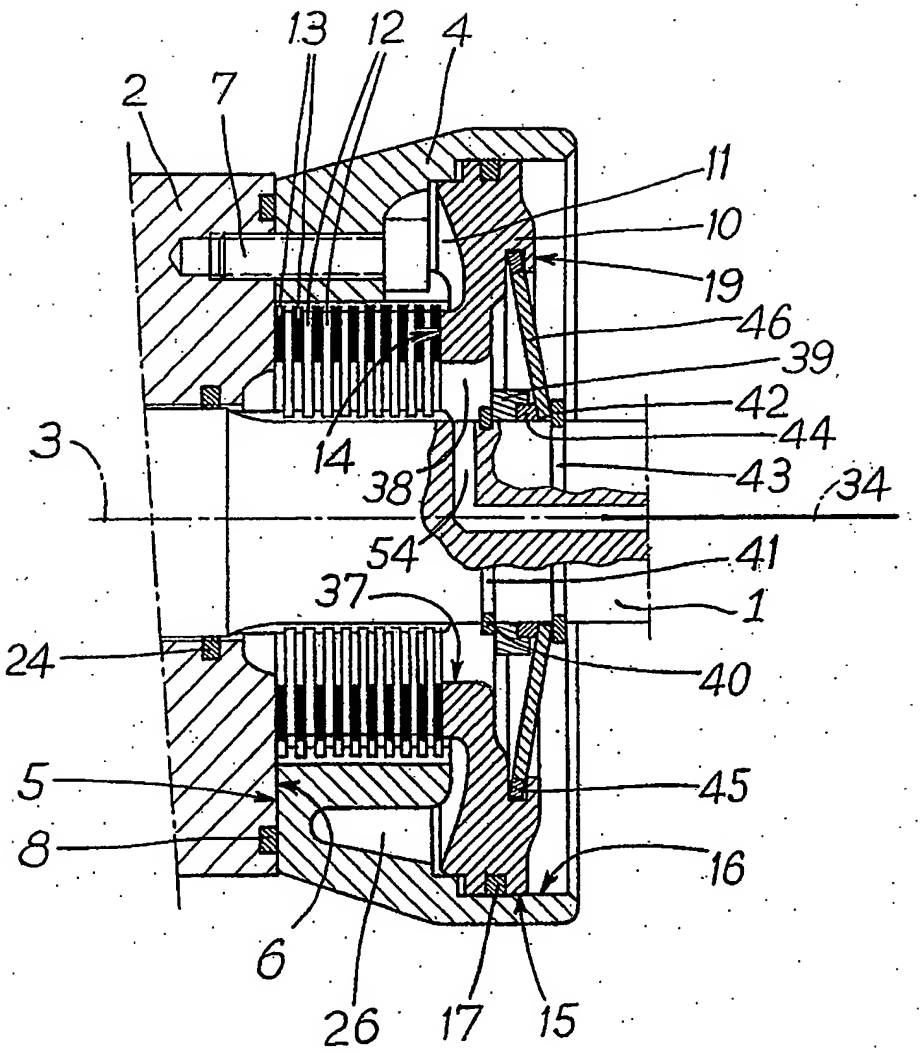
Fig.2

Fig.4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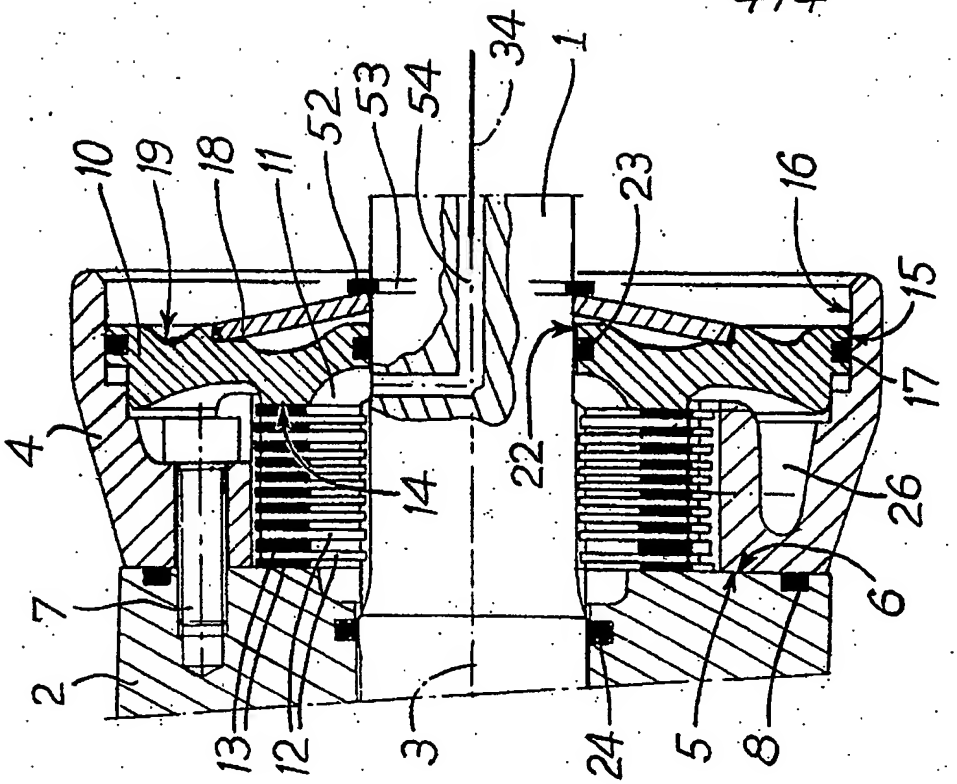
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Fig. 6

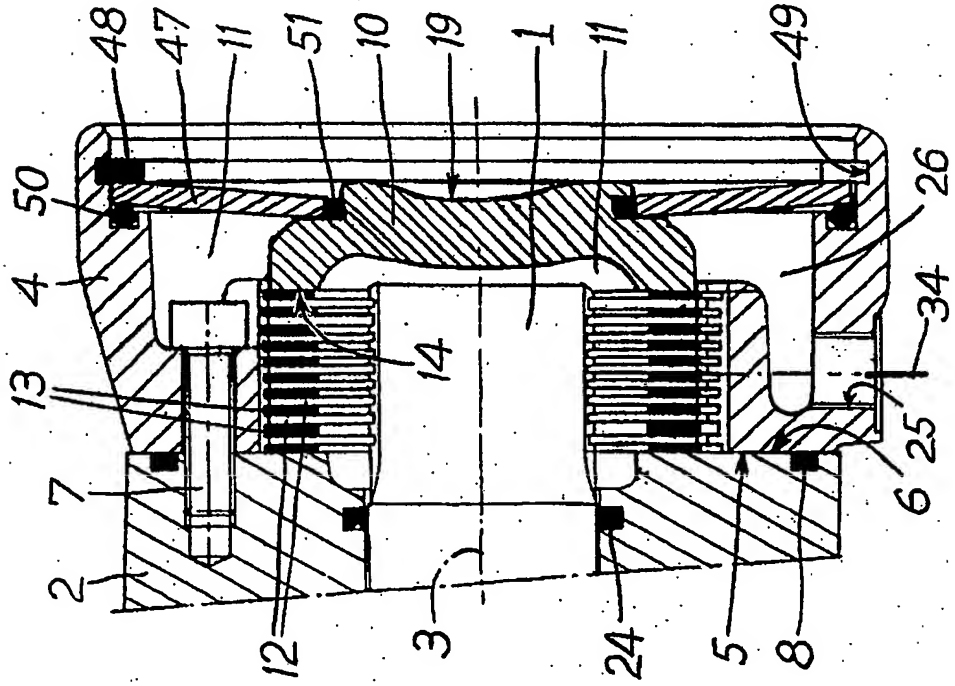
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Fig. 5

SPECIFICATION

A disc brake device provided with a brake release controlled by fluid pressure

Multi-disc brakes in oil provided with mechanical braking under the action of return springs and braking release by fluid under pressure are already known. Such devices may include a chamber containing oil at atmospheric pressure and the brake discs; an open air chamber containing the springs necessary for mechanical braking; and a chamber having excess pressure with respect to the air chamber, separated from the air chamber by a brake piston, permitting hydraulic brake release during operation.

The chamber containing the discs is separated from that in which the piston works. This produces a number of disadvantages. The brake release piston has a relatively small diameter and thus the braking control springs must have relatively low return forces, so as to be able to be released with a predetermined pressure. The corresponding braking may be insufficient unless, of course, an increase in the diameter of the brake release piston and thus the space occupied by the brake is accepted. The increase in the pressure itself is not a simple operation since it generally involves a necessary increase in the dimensions of the various parts.

The object of the invention is to overcome these disadvantages of known brakes as well as to propose a simplification of their construction.

Thus, the invention provides a device for braking relative rotation of first and second members; the device comprising: a housing rotationally fast with the first member; a cover for the housing applied to the housing in a fluid tight manner so as to define therewith a chamber, at least part of the said cover being axially movable with respect to the first member; at least one brake disc rotationally fast with one of said members; at least one brake lining rotationally fast with the other of said members, the at least one brake disc and the at least one brake lining being arranged alternately inside the chamber; resilient biasing means acting between the said axially movable part of the cover and one of the said members, said biasing means applying a permanent bias to said movable part of the cover tending to urge the brake linings into engagement with the brake discs; and a fluid tight seal between the second member and the assembly of the housing and the first member, said seal closing the chamber in a fluid tight manner whereby brake release fluid under pressure may be selectively supplied to the chamber to act on the movable part of the cover in opposition to the biasing means and thereby relieve the brake discs and linings of the biasing effect of the biasing means.

The invention will be better understood and secondary characteristics and their advantages will become apparent in the course of the description of embodiments given below by way of example.

It is understood that the description and the drawings are only provided by way of information and are not limiting.

Reference will be made to the accompanying drawings in which:

Figure 1 is a view partially diagrammatic and partially in axial section of a braking device in accordance with the invention; and

Figures 2 to 6 are axial sections similar to that for Figure 1 of variants in accordance with the invention.

Each braking device in Figures 1 to 6 is designed for the braking of a shaft 1 mounted for rotation with respect to a frame 2 about an axis of rotation 3. In the Example shown, the frame 2 constitutes the body of an hydraulic motor and the shaft 1 constitutes an extension of the shaft of the motor.

The housing 4 of the braking device comprises a plane surface 5 which is applied to a plane transverse surface 6 which the frame 2 comprises, the housing being made fast with the frame by means of screws 7. A fluid tight joint 8 is arranged in a groove in the frame and supported on the surface 5 of the housing, rendering the assembly plane 9 of the housing and the frame fluid tight.

In the six embodiments, the housing 4 is hollow and is closed either by a cover 10 (Figures 1 to 3, and 6) or by the cover 10 and a resilient associated washer 46, 47 (Figures 4 and 5). Thus, a closed chamber 11 is provided in the housing within which are arranged brake discs 12 rotationally fast with the shaft 1, as well as brake linings 13 rotationally fast with the inner wall of the housing, one lining being interposed between two successive discs, and in known manner, the axial succession of the brake discs and the brake linings commencing at one end and finishing at the other end of the stack with a brake lining 13.

A boss 14 on the cover 10 in the form of a crown is arranged facing and is supported by the brake lining 13 at one end of the said stack. It is to be noted that in Figures 1, 2, 4 and 6, the cover 10 is mounted at its periphery 15 by axial sliding in a bore 16, having the axis 3, provided in the end of the housing 4 opposite to the surface 5. A fluid tight (sliding) joint 17 is arranged between the bore 16 and the periphery 15 of the cover.

In the embodiments of Figures 1 and 2, a compression spring 18 constituted by a "Belville" washer is held against the outside 19 of the cover 10 by a ring fixed in a groove 21 provided in the end of the housing. The effect of the spring 18, is to bias the brake discs 12 and the brake linings 13 against each other, to brake the shaft one with respect to the housing 4 (and thus with respect to the frame 2).

In the embodiments of Figures 1 and 6, the shaft 1 passes through a central opening 22 in the cover 10 with the interposition of a fluid tight annular seal 33.

In the embodiment of Figure 4, the shaft 1 also passes through a central opening 37 in the cover 10 but with a large space 38 such that no fluid tight joint is formed between the opening 37 and the shaft 1. A ring 39 is fixed axially with respect

to the shaft by a ring 40 located in a groove 41 in the shaft. A resilient washer 46 of the "Bellville" type for example, is supported by a ring 42 located in a groove 43 in the shaft 1, by the cover 10 in order to bring the cover into engagement with the brake linings 13, and by two toric fluid tight seals 44, 45. Seal 44 is interposed between the washer 46, the ring 39, and the shaft 1, and the seal 45 is interposed between the washer 46 and the cover 10.

In the embodiments of Figures 2, 3 and 5, the cover 10 is imperforate. In Figures 2 and 3, the cover totally closes the opening in the housing 4. On the other hand, in Figure 5, the cover 10 only occupies the central portion of the said opening, the remainder thereof being closed by a resilient washer 47 maintaining the cover in engagement with the brake linings 13. To this end, the resilient washer 47 is supported by a ring 48 contained in a groove 49 in the opening in the housing 4. Two fluid tight seals 50 and 51 are interposed between the washer 47 and the housing 4, the cover 10 respectively.

It is to be noted that in the embodiment of Figure 6 the shaft 1 passes through the cover 10 by way of a fluid tight seal 23, the resilient washer 18 being supported by a ring 52 located in a groove 53 in the shaft 1 in order to urge the cover 10 into engagement with the brake linings 13 without it being necessary to interpose any form of fluid tight joint between the washer 18 and the other parts.

In all cases, the shaft 1 passes through the frame 2 with the interposition of a fluid tight annular seal 24. Thus, the chamber 11 is itself completely isolated from the exterior.

In the embodiment of Figures 1, 2, 3 and 5, a union 25 opens into a peripheral chamber 26 in the housing and enables the chamber 11 to be selectively connected to a pump 27, the peripheral chamber 26 and the chamber 11 being in permanent communication and forming in fact two parts of the same chamber.

The inlet pipe 35 of the pump 27 is connected to a reservoir 28 the outlet pipe 29 of the pump is connected to a fluid distributor 30. A pipe 31 connects the distributor 30 to the reservoir 28, and a pipe 32 connects the delivery pipe 29 to the reservoir 28 via a calibrated discharge valve 33. Finally, a pipe 34 connects the distributor 30 to the union 25.

The distributor 30 has three positions of which the first corresponds to communication between the pipes 29 and 34 and the blocking of the pipe 31; the second corresponds to the communication between the pipes 29 and 31 and the blocking of the pipe 34; and the third corresponds to the communication between the pipes 29, 31 and 34.

The device for delivering fluid under pressure comprising the pump 27, the reservoir 28 and the distributor 30, is retained in the embodiments of Figures 4 and 6 (but is not shown since it is identical). The only difference resides in the fact that the pipe 34 is connected to a duct 54 provided in the shaft 1 itself, and opening directly into the chamber 11 (in Figure 4, into the zone of the space 38 of the said chamber 11).

The cover 10 in the embodiments of Figures 1, 2, 4, 5 and 6 is rigid, substantially undeformable and its boss 14 is only in engagement with one of the brake linings 13 under the action of the resilient force of the resilient washer (18, 46, 47).

In the embodiment of Figure 3, the cover 10 is axially resilient and for this reason itself constitutes the biasing spring the effect of which is to urge the boss 14 of the cover into engagement with one of the brake linings 13. Thus, it is no longer necessary to provide a separate spring 18. Of course, it remains necessary to provide a supporting element on the housing for the element ensuring the resilient function, that is to say for the periphery 15 of the cover 10: the fixed ring 20 and the groove 21 provide this support element. It is also advisable to note that the periphery 15 of the cover 10 is no longer mounted to slide with respect to the housing 4 the end of which has not been machined into a bore for that reason. On the contrary, a fluid tight seal 36 (in compression) is interposed between the housing 4 and the periphery 15 of the cover 10.

Finally, it should be noted that if, in the embodiments shown, the housing 4 constitutes a separate part from the frame 2 to which it is assembled with the interposition of a fluid tight seal 8, clearly an equivalent embodiment would consist in producing the housing as a single piece with the frame.

The advantages in the arrangements which have just been described will be noted hereafter.

First of all, the permanent communication of the chamber 11 and the chamber 26, or their combination into a single chamber, causes the brake release fluid, coming from the pump 27 when the distributor 30 is placed in its first position, to act on the total cross section of the cover 10 (Figures 1, 2, 3 and 6) or on the transverse section of the cover 10 and resilient washer 46, 47 (Figures 4 and 5). This section is clearly greater than that of the brake release piston of the prior art arrangements.

Thus, it becomes possible either to produce the brake release by using a fluid pressure identical to the earlier pressure used or to use a pressure lower than that previously used. When the pressure selected is the same as the previous pressure, brake release force is greater than it was previously which makes possible the use of a spring (18, 46, 47) having a return force greater than the springs previously used. In this case, the braking force is improved (greater than that which it was previously). However, it is also possible whilst preserving the same braking force and thus the same brake release force as previously, to adopt a brake release pressure lower than the pressure previously used, which could sometimes be of interest.

When the shaft 1 passes through the cover 10 (Figures 1, 4, 6) the above mentioned advantage

is still obtained. Evidence shows that this advantage is even more significant when the shaft does not pass through the cover 10 (Figures 2, 3, 5) and when the complete transverse section then acts as a brake release piston.

It should also be noted that the chamber 11 is isolated from the mechanism contained in the frame 2, by means of the fluid tight seal 24. Thus, in a novel manner, there is no risk of polluting the mechanism protected by the frame 2 by the fluid (oil) which is contained in the chamber 11 and in which abrasive particles from the brake linings and/or brake discs may be suspended. This is of quite particular interest when the said frame is that of an hydraulic motor the operation of which cannot endure a possible pollution. Moreover, since the brake and motor fluids are isolated one from the other, they may be different and specific to each of the corresponding functions.

The embodiment of Figure 3 in which the cover 10 also ensures the resilient biasing function, is advantageous in view of its simplicity.

Finally, it should be noted that because the surface 19 of the cover 10 is in free communication with the atmosphere, the displacement of the cover 10 during brake release is effected without counter pressure. Any travel away from or towards the chamber 11 of a volume of oil equal to the volume displaced by the brake piston during its active course, is not produced, which contributes in reducing the response time of the arrangement both during braking and during brake release.

Moreover, the operation of the brake is entirely independent of that of the mechanism on which the brake is mounted.

The invention is not limited to the embodiments described but, on the contrary, covers any variant which could be made to it without departing from its scope or its concept.

CLAIMS

1. A device for braking relative rotation of first and second members; the device comprising: a housing rotationally fast with the first member; a cover for the housing applied to the housing in a fluid tight manner so as to define therewith a chamber, at least part of the said cover being axially movable with respect to the first member; at least one brake disc rotationally fast with one of said members; at least one brake lining rotationally fast with the other of said members, the at least one brake disc and the at least one brake lining being arranged alternately inside the chamber; resilient biasing means acting between the said axially movable part of the cover and one of the said members, said biasing means applying a permanent bias to said movable part of the cover tending to urge the brake linings into engagement with the brake discs; and a fluid tight seal between the second member and the assembly of the housing and the first member, said seal closing the chamber in a fluid tight manner whereby brake release fluid under pressure may be selectively supplied to the chamber to act on the movable part of the cover in opposition to the biasing means and thereby relieve the brake discs and linings of the biasing effect of the biasing means.

2. A braking device according to claim 1, wherein one of the ends of the housing defines a bore in which at least a portion of the cover is mounted for sliding in a fluid tight manner.

3. A braking device according to claim 2, wherein the cover is rigid and the biasing means are separate from the cover.

4. A braking device according to claim 3, wherein the second member passes through the cover, the biasing means are arranged between the second member and the cover, and an annular fluid tight seal is disposed between the said bore and the cover.

5. A braking device according to claim 4, wherein a clearance space is provided between the second member and the cover, and the biasing means comprises at least one annular resilient washer, fluid tight seals being arranged between the said washer and the second member and the cover respectively.

6. A braking device according to claim 4, wherein a fluid tight seal is arranged between the second member and the cover.

7. A braking device according to claim 3, wherein the biasing means are arranged between the housing and the cover.

8. A braking device according to claim 7, wherein the cover is integral and imperforate.

9. A braking device according to claim 7, wherein the cover is a composite assembly comprising a central thrust portion and an annular resilient washer, fluid tight seals being arranged between the said resilient washer and the thrust portion on the one hand and the housing on the other hand.

10. A braking device according to claim 7, wherein the second member passes through the cover and an annular fluid tight seal is arranged between the said second member and the cover.

11. A braking device according to claim 1, wherein the cover is axially resilient with the central portion of the cover being movable with respect to the periphery of the said cover, the periphery being supported by the housing and being maintained thereon by means engaging in a groove in the housing.

12. A braking device according to claim 11, wherein the biasing means are constituted by the cover itself.

13. A braking device substantially as herein described with reference to the drawings.

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